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**MONETARY GROWTH EFFECTS ON THE U.S. ECONOMY**

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By

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## INTRODUCTION

This paper has been motivated by recent work of Treadway et al. (1986) about monetary growth effects on the spanish economy.

Treadway et al. proposed a theoretical framework to deal with monetary phenomena. We employ this theoretical framework to elaborate, with yearly data (1953-1983), a simple model for the U.S. economy, and study the monetary growth effects on this economy. We study Monetary Neutrality, Monetary Superneutrality, and Lack of Monetary Effects.

The organization of this paper is as follows:

Section I states the above hypothesis. Section II describes the theoretical framework. Section III is dedicated to the estimation process results. Finally Section IV summarizes the main conclusions.

## SECTION I

### NEUTRALITY, SUPERNEUTRALITY AND LACK OF MONETARY EFFECTS

Monetary Neutrality states that a permanent change in the level of the nominal money stock, has no long-run effects on any real variable.

Monetary Superneutrality states that a permanent change in the rate of growth of the nominal money stock, has no long-run effect on any real variable.

Lack of Monetary Effects states that the nominal money stock, has no influence on the real economy even in the short-run.

For the U.S. economy, this paper shows some empirical evidence against Superneutrality and Lack of Monetary Effects. Monetary Neutrality is accepted and incorporated to the empirical model in order to gain efficiency<sup>1</sup>.

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<sup>1</sup>Treadway et ell. obtain similar results for the Spanish economy.



## SECTION II

### THE THEORETICAL MODEL

We assume the existence of two sectors of economic agents: (1) Sector "T" of "keepers" of the nominal money stock at any time period. (2) Sector "C" that "creates" the increment of this nominal stock at any time period.

Sector "C" determines the rate of monetary growth knowing and possibly reacting to the past of the complete system. Sector "T" determines the real variables (the real state of the economy) knowing the past of the system plus the present value of the nominal money stock.

We postulate a general and stable set of dynamic equations that represent the effects of the nominal money stock on the levels of the real variables. The nominal money stock is not the unique explanatory variable in determining the state of the real economy, and therefore we specify a general linear multivariate stochastic model for the noise of this set of equations.

Along with this set of relationships, we postulate a feedback relationship. It expresses the rate of money growth dependence from the real economy. In this case, the error follows a general linear univariate stochastic process.

This theoretical framework has two important features:

(1) It is mathematically formulated as a general linear multivariate stochastic process, i.e. it is general from a mathematical point of view and integrated with the econometrics of time series.

(2) It does not incorporate any a priori hypothesis which are able to be empirically tested, i.e. it is general from an economic theory point of view.

## THE THEORETICAL MODEL

### Sector "T"

$$Z_t = \nu_z(B) X_t + N_{zt} \quad (1.1)$$

$$(nx1) \quad (nx1) \quad (1x1) \quad (nx1)$$

$$\pi_z(B) N_{zt} = a_{zt} \quad (1.2)$$

$$(nxn) \quad (nx1) \quad (nx1)$$

### Sector "C"

$$\nu_x(B) Z_t + N_{xt} \quad (2.1)$$

$$(1x1) \quad (1xn) \quad (nx1) \quad (1x1)$$

$$\pi_x(B) N_{xt} = a_{xt} \quad (2.2)$$

$$(1x1) \quad (1x1) \quad (1x1)$$

Where:

- $Z_t$        $\rightarrow$     is a vector of real variables
- $v_z(B)$   $\rightarrow$     is a vector of stable transfer functions
- $X_t$        $\rightarrow$     is the nominal money stock
- $N_{zt}$       $\rightarrow$     is a noise term that follows a general,  
linear, non-explosive, invertible, multiva-  
riate stochastic model represented by (1.2)
- $v_x(B)$   $\rightarrow$     is a vector of stable transfer functions
- $N_{xt}$       $\rightarrow$     is a noise term that follows a general  
linear, non-explosive, invertible, univa-  
riate, stochastic model represented by (2.2)

BASIC HYPOTHESIS:

a) Independence

$$E(a_{zt} a_{xt'}) = 0 \quad \text{for all } t \text{ \& } t' \quad (3)$$

b) Lack of contemporaneous feedback

$$v_x(0) = 0 \quad (4)$$



MULTIVARIATE STOCHASTIC REPRESENTATIONS OF THE  
THEORETICAL MODEL

GENERAL REPRESENTATION:

$$\begin{bmatrix} \pi_z(B) - \pi_x(B) \nu_{z0} \nu_x(B) & \nu_{z0} \pi_x(B) \nabla - \pi_x(B) \nu_z(B) \\ -\pi_x(B) \nu_x(B) & \pi_x(B) \nabla \end{bmatrix} \begin{bmatrix} Z_t \\ X_t \end{bmatrix} = \begin{bmatrix} a_{zt}^* \\ a_{xt} \end{bmatrix}$$

Where:

$$a_{zt}^* = a_{zt} + \nu_{z0} a_{xt} \quad \text{and}$$

$$\Sigma^* = \begin{bmatrix} \Sigma_z + \nu_{z0} \nu_{z0}^t \sigma_x^2 & \nu_{z0} \sigma_x^2 \\ \nu_{z0}^t \sigma_x^2 & \sigma_x^2 \end{bmatrix}$$

GENERAL REPRESENTATION UNDER MONETARY NEUTRALITY:

$$\begin{bmatrix} \pi_z(B) - \pi_x(B) \nu_{z0} \nu_x(B) & \nu_{z0} \pi_x(B) - \pi_z(B) \nu_z^*(B) \\ -\pi_x(B) \nu_x(B) & \pi_x(B) \end{bmatrix} \begin{bmatrix} Z_t \\ \nabla X_t \end{bmatrix} = \begin{bmatrix} a_{zt}^* \\ a_{xt} \end{bmatrix}$$

$$\text{With Neutrality:} \quad \nu_z(B) = \nu_z^*(B) \nabla.$$

### SECTION III

#### ESTIMATION RESULTS

In this Section we present the final results of the estimation procedure. From the empirical multivariate stochastic model, previously elaborated, we estimate the parameters of the theoretical multivariate stochastic model.

We show those results divided by sectors as the theoretical model in Section II.

The real vector "Z" contains:  $\ln(M1/P)$ ,  $\ln(PNBU)$  and  $\ln(1+RC)$ . "M1" is the nominal money stock, "PNBU" is the GNP for the U.S. economy, "P" is the GNP's deflator, and "RC" is the Treasury Bills rate of interest<sup>2</sup>.

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<sup>2</sup> $\ln$  represents the natural logarithm.

Sector "T"

$$\begin{bmatrix} \ln(M1/P)_t \\ \ln PNB U_t \\ \ln(1 + RC_t) \end{bmatrix} = \begin{bmatrix} \frac{(1.11 + .05B)(1 + .50B + .40B^2)}{(1 - .30B)} \\ (.81B)(1 + .50B + .40B^2) \\ \frac{(-.11 + .48B)(1 + .50B + .40B^2)}{(1 - .37B)} \end{bmatrix} \nabla \ln M1_t + \begin{bmatrix} N_{st} \\ N_{yt} \\ N_{rt} \end{bmatrix}$$

$$\hat{g}_s^* = \begin{matrix} 3.15 \\ (1.33) \end{matrix} \quad \hat{g}_y^* = \begin{matrix} 1.54 \\ (.49) \end{matrix} \quad \hat{g}_r^* = \begin{matrix} 1.12 \\ (.41) \end{matrix}$$

$$\begin{bmatrix} (1 - .30B)\nabla & 0 & (.42B - .16B^2)\nabla \\ 0 & \nabla & (1.90B - .70B^2)\nabla \\ 0 & 0 & (1 - .37B)\nabla \end{bmatrix} \begin{bmatrix} N_{st} \\ N_{yt} \\ N_{rt} \end{bmatrix} = \begin{bmatrix} a_{st} \\ a_{yt} \\ a_{rt} \end{bmatrix}$$

Sector C

$$\nabla \ln M1_t = \begin{pmatrix} 0 & 0 & 0 \end{pmatrix} \begin{bmatrix} \ln(M1/P)_t \\ \ln PNB U_t \\ \ln(1+RC_t) \end{bmatrix} + N_{xt}$$

$$(1 + .50B + .40B^2) \nabla N_{xt} = a_{xt}$$

$$\Sigma = \begin{bmatrix} .08 & & & \\ - .01 & .19 & & \\ - .03 & .03 & .04 & \\ 0 & 0 & 0 & .37 \end{bmatrix} \times 10^{-3} \quad P = \begin{bmatrix} 1 & & & \\ - .06 & 1 & & \\ - .53 & .34 & 1 & \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\pm 2/\sqrt{n} = \pm .37$$

$$\hat{\sigma}_{a_s} \times 100 = .9; \hat{\sigma}_{a_y} \times 100 = 1.4; \hat{\sigma}_{a_r} \times 100 = .6; \hat{\sigma}_x \times 100 = 1.8$$

$$\bar{R}_s^2 = .85 \quad \bar{R}_y^2 = .63 \quad \bar{R}_r^2 = .68 \quad \bar{R}_x^2 = .22$$

corrected and computed on stationary series

Univariate Stochastic Models:

$$\hat{\sigma}_{a_s} \times 100 = 2.3; \hat{\sigma}_{a_y} \times 100 = 2.5; \hat{\sigma}_{a_r} \times 100 = 1.3; \hat{\sigma}_x \times 100 = 1.8$$

$$\bar{R}_s^2 = .38 \quad \bar{R}_y^2 = .0 \quad \bar{R}_r^2 = .35 \quad \bar{R}_x^2 = .22$$

corrected and computed on stationary series

## SECTION IV

### CONCLUSIONS

In order to study the effects of monetary growth in the U.S. econmy, we first elaborate a theoretical framework which shows two very important features:

a) It is mathematically formulated as a multivariate stochastic model. Among the availables, this is the most general mathematical formulation, and it is our solution to the problem of integrating Economic Theory and empirical analisys of Time Series.

b) This theoretical framework is also general from a theoretical point of view. It does not incorporate any a priori restrictions without their previous empirical testing.

We second estimate the parameters of the theoretical model elaborating an empirical multivariate stochastic process.

Finally, we test the hypotheses: Monetary Neutrality, Superneutrality and lack of Monetary Effects. Superneutrality and lack of Monetary Effects are rejected for the U.S. economy. Neutrality cannot be rejected, and it is incorporated into the empirical model to improve efficiency. Those results are similar to Treadways' for the Spanish economy.



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